



## REM TECHNICAL NOTE CS-ES-3.4

### UNDERWATER CLEANING OF CONCRETE AND STEEL: ABRASIVE WATERJETS

PURPOSE: To provide information on the use of hydraulic abrasive waterjets for removing fouling and corrosion from underwater structures.

APPLICATION: Abrasive waterjets are recommended for removing paint and protective coatings from underwater steel surfaces. Diver-operated waterjet systems that use abrasives are effective in removing fouling, corrosion, and paint from metal surfaces. Abrasive waterjet cleaning is typically required to obtain a bare metal finish before certain maintenance and repair operations, such as welding and painting, can be performed.

ADVANTAGES: Cleaning rates of 4 sq ft/min can be achieved with abrasive waterjet systems. Often, underwater sandblasting with abrasive waterjets is the only way to obtain a 100 percent bare metal finish. Other methods may not be able to remove all paints and protective coatings or may be too time-consuming to be cost-effective. Also, abrasive waterjets etch the metal surface to ensure a good bond for new coatings.

LIMITATIONS: Abrasive waterjet cleaning systems tend to be more expensive than water-only systems. Their added cost is the result of the additional grit handling and mixing equipment that is required to inject the abrasives into the waterjet stream. Additionally, extra care must be taken during the operation of the system to prevent the abrasive supply lines from clogging.

Abrasive injection systems will remove paint and protective coatings from underwater steel surfaces. If it is necessary to leave the paint or coatings intact, then another cleaning device, such as a waterjet without abrasives, should be used.

Handling a high-pressure waterjet device is a potentially dangerous operation. Operating and safety procedures must be carefully followed by a diver using an underwater waterjet tool. All personnel should be aware of the operational hazards and receive proper training before underwater operation.

PERSONNEL REQUIREMENTS: A trained and qualified scuba diver is required to operate an abrasive waterjet system underwater. Another person is required to operate the controls and monitor the performance of the power source. Depending upon the system, an additional person may be required to periodically refill the sand hopper. Typically, a diving supervisor is required to monitor the diving operations and also to control a topside on/off foot valve for added safety.

EQUIPMENT DESCRIPTION: The components of an abrasive waterjet system include a pump/power source, a waterjet tool, a sand or grit hopper, an air/grit pump, and interconnecting hardware, such as hoses and connectors. Two types of

abrasive waterjet systems are available: a slurry system and a dry grit system.

In a slurry system (Figure 1) the grit and water are mixed topside and delivered to the nozzle via the same line in a slurry mixture. This system uses a special mixing device to create the slurry at the power control unit.

In a dry grit system (Figure 2) the abrasive is delivered to the nozzle in a separate "dry" line. The grit is then mixed at the nozzle with pressurized water. The grit hopper must be refilled periodically. A separate on/off valve is required to stop the flow of abrasives to the work site.

Both the dry grit and slurry systems are counterthrust with a water-only retrojet nozzle. Water pressures and flow rates for these systems range from 6,000 to 10,000 psi and 14 to 26 gpm. Half of the flow is directed out the retrojet to balance the reaction forces. The waterjet gun includes an on/off safety lock and a trigger guard to prevent accidental operation of the tool. Lower flow rates and pressures should be used to clean underwater timber structures to avoid damaging the timber itself.

Commercial manufacturers include Jetin-Sullair, Inc., and Harben, Inc. Jetin offers an offshore module which can be used as either a slurry or water-only cleaning system.

COSTS: The cost for purchasing a complete underwater abrasive waterjet cleaning system ranges from approximately \$30,000 to \$50,000 depending upon the pump and power source requirements. If a suitable pump/power source is available, the abrasive cleaning components (grit hopper, air/slurry pump, and abrasive waterjet tool) can be acquired for less than \$10,000.

MANUFACTURERS: Harben, Inc.  
Route 10, Box 163  
Cumming, GA 30130  
Tel 404-889-9535  
  
Jetin-Sullair, Inc.  
5131 NE Union Ave  
Portland, OR 97211  
Tel 503-249-8191

ENVIRONMENTAL CONSIDERATIONS: Cleaning operations with the equipment discussed in this Technical Note may increase the level of suspended and soluble materials in the water column adjacent to and downstream from the operation. Whether these increases will result in unacceptable water quality or other undesirable environmental consequences should be evaluated on a project-specific basis. Variables that influence the nature and magnitude of any impacts include, but may not be limited to: the hydrodynamic setting, the physical and chemical characteristics of the sediment or residue generated during the cleaning or dredging process, and the regulatory environment. Personnel familiar with evaluating water quality impacts of construction operations should be consulted during the early stages of project planning to ensure that appropriate water quality criteria and other environmental regulations will be met.



Figure 1. Harben submersible abrasive blasting system.

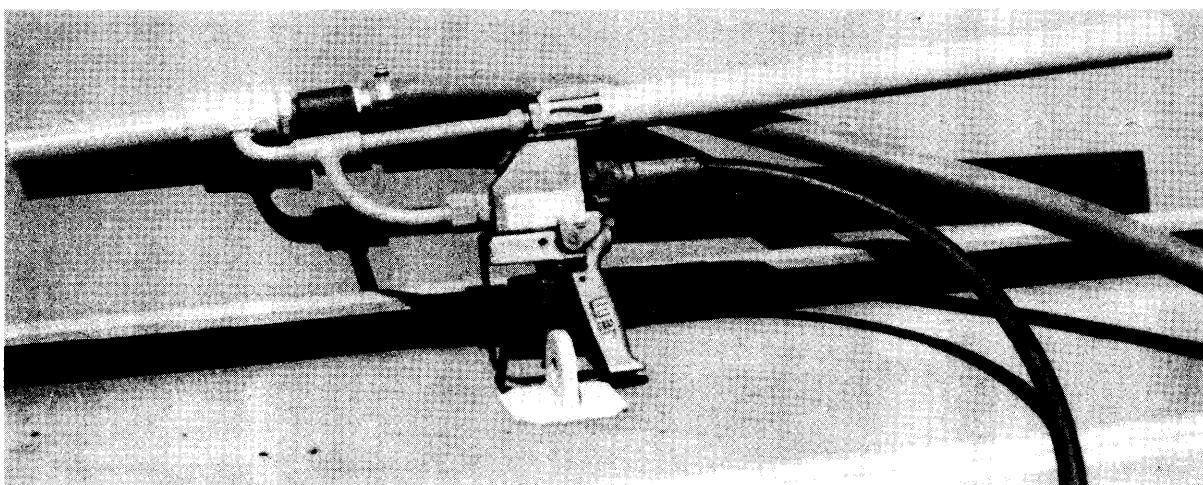


Figure 2. Jetin dry abrasive waterjet tool.

REFERENCES:

- a. Underwater surface cleaning of waterfront structures. C. A. Keeney. Naval Civil Engineering Laboratory, Port Hueneme, CA, Feb 1981. TN-1602.
- b. Procedures and devices for underwater cleaning of civil works structures. C. A. Keeney, Naval Civil Engineering Laboratory, Port Hueneme, CA. Prepared for US Army Engineer Waterways Experiment

Station, Vicksburg, MS. Technical Report REMR-CS-8 (in preparation).